PATENT SPECIFICATION

Inventor: EDWIN ANTHONY MAY

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COMPLETE SPECIFICATION

Improvements in Hypodermic Injection apparatus

We, BECTON DICKINSON and COMPANY, a corporation of the State of New Jersey, United States of America, of Stanley and Cornelia Streets, East Rutherford, County of Bergen, and State of New Jersey, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an improved injection device for administering medicaments hypodermically without the use of a skin-piercing needle.

The invention is designed to provide a new or improved construction for a hypodermic injection device of this kind.

According to the invention, a tubular member adapted to contain gas under pressure is slidably mounted for movement between projected and retracted positions within a hollow body or casing which is provided with a medicament chamber adjacent to its outer end, the said tubular member having means adjacent to one of its ends and movable therewith to cooperate with and expel medicament from the medicament chamber, a stem or plunger being mounted on or abutting against the body or casing adjacent to the rear end thereof and extending into the bore of the tubular member, and movable means being mounted on the body and operable to retract the tubular member relatively to the stem or plunger which is thereby caused to extend further into the bore of the tubular member thus increasing the pressure of the gas within the tubular member and serving as a reaction member for the said gas to move the tubular member to its projected position.

In order that the invention may be clearly understood and readily carried into effect, a hypodermic injection device constructed according to the invention, together with a modification, will now be more fully described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is a sectional side view of the device,

Figure 2 is section taken along the line 2—2 in the direction of the arrows as indicated in Figure 1;

Figure 3 is an enlarged transverse sectional view taken along the line 3—3 in the direction of the arrows as also indicated in Figure 1,

Figure 4 is a sectional view of a loading assembly for the device, and

Figure 5 is a fragmentary sectional view of an alternative construction.

Referring primarily to Fig. 1 of the drawings, it will be seen that the numeral 5 indicates the body or barrel of the device to which a nose piece or extension 6 is secured as, for example, by screw threads. To the forward end of this extension 6 and the loading cap 7 are proagain by screw threads, if desired. The extension 6 and the loading cap 7 are provided with internal bores defining a medicament receiving chamber. Instead of having a fluid medicament disposed in direct contact with the wall of the chamber, that medicament is preferably contained in an ampoule or like receptacle. Such ampoule may take any one of numerous different forms including for example, a rubber sac which is invertible upon itself and which is provided adjacent its forward end with an orifice-defining member. In the drawings, the ampoule has been illustrated as comprising a tubular body preferably formed of glass. This is to be taken in an illustrative rather than a limiting sense.

Thus, while in all instances it is preferred to have the enlarged bores defining

[*Price 2s. 8d.*]

the medicament chamber lined with displaceable material, such as rubber sleeves 8 and 9 secured against movement with respect to the extension and loading cap by, for example, annular ribs 10, a glass ampoule in the form of a tube 11 has been shown in this figure. That ampoule has a stopper 12 of the piston type, the stopper 12 being disposed adjacent to the rear end of the ampoule prior to discharge of medicament, but movable along the ampoule to effect such discharge. Adjacent its forward or outer end the ampoule is provided with a perforable stopper 13. Between these stoppers the medicament to be injected is disposed. A nozzle 14 extends through a central aperture in the outer face of the loading cap 7, the nozzle being conveniently formed with a base portion 15 having a diameter substantially equal to that of the head of the stopper 13. The nozzle has an orifice 16 adjacent its outer end and the diameter of that orifice is relatively fine, preferably being within the range of from .003" to .012". The nozzle also conveniently mounts an inwardly extending pointed cannula 17 of a length adequate to pierce the stopper 13 and establish communication with the interior of the ampoule.

In order to eject the medicament from the chamber defined by the extension 6 and loading cap 7, a plunger 18 is projectible through a bore of proper size in the extension 6. This plunger has secured to it an extension 19 conveniently formed of rubber or the like, and which has a diameter such that it may enter the bore of the tube 11. While this extension 19 may be secured to the plunger 18 in any desired manner, it is preferred to employ a bolt 20 the threads of which engage with corresponding threads in a bore formed in the outer end of the plunger 18. This bolt 20 is provided with a headed portion keying into a correspondingly contoured recess formed in the rear end of the extension 19 to retain the latter for reciprocation with the plunger.

It is apparent that with a filled ampoule disposed in the medicament chamber if the plunger 18 is projected with sufficient force, the extension 19 will be caused to exert pressure on the stopper 12 such that the latter will be moved along the bore of the tube 11. At this time it will be noted that the length of the medicament chamber is such that the rear edge of the tube 11 is spaced from the rear end of that chamber. Accordingly the adjacent portions of the sleeve 8 will intervene these parts. Therefore, the extension 19 will contact these end portions of the sleeve 8.

Under the forces employed, the extension 19, upon being projected, will tend to be displaced into the rear end of the medicament chamber, and therefore it will engage with the rear end portions of the sleeve 8 and tend to displace the material of the latter. This force will also act through the sleeve 8 upon the sleeve 9, pressing against the rear end edge of the sleeve 9. Under these forces both the sleeves 8 and 9 will tend to constrict to thus reduce the bore of the medicament chamber. With such action they will move into intimate supporting relationship with the outer face of the ampoule tube 11, and will therefore support that tube against internal bursting pressures. A construction of this type is especially desirable where the ampoule is formed of glass or similarly frangible material. Regardless of this co-operation of the parts, it will be understood that with the forward projection of the stopper or piston 12, medicament will be ejected through the bore of the cannula 17 and the orifice 16. The ejection occurring under sufficient pressures and the end of the nozzle being in contact with or adjacent to the skin at a point overlying the area to be injected, it follows that the stream of medicament will pass through the epidermis and into the underlying tissues.

Now with a view to producing a force adequate to cause movement of the plunger 18 in the manner desired, it will be noted that this plunger terminates in a base portion 21. This base is secured, for example, by screw threads, to the forward end of an actuating tube 22 slidably disposed within the casing 5. Conveniently, a packing member in the form of a sealing ring 22^1 of the kind known as an "O-ring" is disposed adjacent to the point of juncture of the base 21 and the tube 22. The interior of that tube serves as a pressure accumulator chamber in a manner hereinafter described and with fluid under pressure within its bore it is apparent that the packing 22^1 will serve to prevent an escape of fluid, for example gas, from the forward end of the tube. A shock absorbing unit, for example in the form of a ring of resilient material as indicated at 23, may be mounted to extend beyond the rear face of the nose piece 6. In such position it will be capable of being engaged by the forward end of the tube 22 and/or the base 21 to prevent damaging contact between these parts.

The casing 5 supports a housing 24, which is provided with an enlarged portion within which there is rotatably mounted a pinion 25. The teeth of the

pinion 25 mesh with the teeth of a rack 26 rigidly secured to and extending from the outer face of the tube 22. The pinion has a shaft on which is mounted adjacent one of its ends a socket portion 27 engageable with the faces of a wrench or like tool which may be of the ratchet type and by means of which the pinion 25 may be turned. The opposite end of this shaft is conveniently retained in position by being grooved and having extending into this portion a key 28 immovably mounted with respect to the side wall of the housing 24. A pawl 29 has its operative end engaging with the teeth of the pinion 25, and is pivotally supported as at 30 adjacent its opposite end between side walls of the housing 24. A spring 31 co-operates with the inner face of the housing and the pawl to normally maintain the pawl in engagement with the pinion teeth. To permit of disengagement of these parts, a shaft 32 of semi-circular cross-section extends across the housing 24 immediately below the pawl 29 and has secured to it a crank or lever 33. When the latter is in the position shown in Fig. 1, the end of the pawl 29 will co-act with the surfaces of the pinion teeth. When the lever 33 is pressed downwardly, then its shaft 32 will act as a cam to raise pawl 29 to a point where it clears the teeth of the pinion.

A closure plug is securely mounted within the rear end of the casing 5. This plug has been indicated by the reference numeral 34, and it serves as an abutment for a stem 35 which extends axially of the bore of the casing and within the latter. If desired, however, the stem 35 may be mounted on the closure plug. A bushing 36 encircles the stem 35 and is formed with grooves in its inner and outer faces to receive suitable packings preferably in the form of packing rings 37 as shown in Fig. 1. This bushing 36 is prevented from moving inwardly with respect to the tube 22 by abutting against a shoulder portion 38 forming a part of the tube 22. With its associated packing the bushing functions as a cylinder in co-operation with the exterior surfaces of the stem 35.

The plug 34 is conveniently formed with a central aperture normally closed by a cap 39. Inwardly of this cap, the stem 35 is formed with a bore 41 which is normally maintained closed by a preferably metallic sealing member 40. Rearward displacement of the bushing 36 with respect to the tube 22 is prevented by a ring 42 preferably having screw threaded engagement with the tube.

As previously stated, the tube 22, in addition to functioning as an actuator for the plunger 18 serves as a pressure accumulator. For this purpose the interior, as well as the bore of the stem 35 may be charged with fluid under suitable pressures. Conveniently the fluid may be nitrogen and the pressures employed may be in the range of from 1,200 to 1,550 pounds to the square inch. Pressures of this value will impart to the medicament an injection pressure of from approximately 3,600 pounds to the square inch to 4,600 pounds to the square inch. Charging of the tube may be effected by removing the closures 39 and 40 and connecting the bore 41 with a source of gas under pressure.

The charging step has been illustrated in Fig. 4, in which 43 indicates a fitting connected with a source of gas under pressure and conveniently provided with a relief valve 44'. This fitting has an extension 44 threaded to engage with the plug 34 and a member 45 rotatably mounted therein carries a wrench part 46 to manipulate the member 40. Packing rings 47 prevent leakage. Accordingly, the interior of the tube may have a pressure charge of, for example, the value indicated. Thereafter, the cap 39 may again be mounted in position.

If the lever 33 is now shifted so that the end of pawl 29 may engage the teeth of the pinion 25, it is apparent that a wrench or handle of suitable type may be coupled to the shaft of the pinion 25 in order to rotate the pinion in a clockwise direction as viewed in Fig. 1. Such rotation of the pinion will cause the rack 26 to be retracted, and in view of the fact that the latter is fixed to the tube 22, that tube will also be retracted. In such retraction it will carry with it the bushing 36, and accordingly the latter will slide over the exterior surface of the stem 35. Therefore, the stem will project increasingly into the bore of the tube 22 to accordingly reduce the interior capacity of the accumulator. This will serve to increase the pressure of the charge which is within the bore of that structure. The teeth of the pinion 25 will be engaged by the pawl 29 to prevent reverse rotation of the pinion and projection of the tube 22 and associated parts.

The foregoing action will continue until the tube 22 is moved to a position at which the foremost of the teeth of the rack 26 is adjacent to the pinion 25. At that time the loading cap 7 may be removed and an ampoule inserted into the medicament chamber, after which the loading cap is remounted upon the extension 6. Of course if a spent or discharged ampoule has heretofore been in position within the medicament chamber

that ampoule is removed before the fresh ampoule is inserted in the manner described. In any event the device is now ready to inject medicament into the tissues.

The locale of injection having been determined, the nozzle 14 is brought into contact with the epidermis overlying this area or else is slightly spaced from that surface. The lever 33 is now shifted. This will cause the cam provided by the shaft section 32 to swing the pawl 29 upwardly against the action of the spring 31 to a point where it clears the teeth of the pinion 25. As such clearance occurs, the pinion is released for rotation. The base of the bore of the stem 35 serves as a reaction point adjacent to one end of the assembly for the gas under pressure. The opposite end of the tube 22 serves as a second reaction point. Therefore the tube 22 together with its plunger 18 will be forcibly projected in order to achieve the desired expulsion of medicament. Thereafter the described cycle of operation may be repeated.

As will be obvious the bushing 36 could be eliminated. This has been shown in Fig. 5. In that view a stem 48 is of heavier gauge than the stem 35 of Fig. 1. A tube 50 lies immediately adjacent and encircles it. The stem 48 is formed with a groove adjacent its outer end to receive a packing such as a sealing ring 49. Thus, an extra packing as well as the bushing may be dispensed with. A covering 51 may be applied over the loading cap, this covering being of rubber or similar material will prevent chilling contact with the patient's skin.

It will be understood that with a structure of this nature the packings are always under pressure. Therefore leakage will be reduced to a minimum, if not entirely eliminated. The device may be easily loaded, cocked and fired. Either glass ampoules or other medicament-containing units may be employed. The depth of penetration may largely be controlled by having the orifice 16 of suitable diameter. The parts are so proportioned that with an ampoule in position, substantially all medicament will be expelled therefrom during the power stroke. If no ampoule is in place, then the forward face of the base portion 21 will engage with the shock absorbing bumper 23 at the end of a power stroke.

To avoid the necessity of removing the plug 40 when charging the tube 22, the plug 40 may be made of penetratable material for example, rubber or the like, so that it can be pierced by a cannula associated with the charging means, and will be self-sealing when the cannula is withdrawn, on account of the resilience of the material of the plug 40.

What we claim is:—

1. A hypodermic injection device in which a tubular member adapted to contain gas under pressure is slidably mounted for movement between projected and retracted positions within a hollow body or casing which is provided with a medicament chamber adjacent to its outer end, the said tubular member having means adjacent to one of its ends and movable therewith to co-operate with and expel medicament from the medicament chamber, a stem or plunger being mounted on or abutting against the body or casing adjacent to the rear end thereof and extending into the bore of the tubular member, and movable means being mounted on the body and operable to retract the tubular member relatively to the stem or plunger which is thereby caused to extend further into the bore of the tubular member thus increasing the pressure of the gas within the tubular member and serving as a reaction member for the said gas to move the tubular member to its projected position.

2. A hypodermic injection device according to Claim 1, in which a bushing is interposed between the said stem and the bore of the tubular member to prevent escape of gas from the tubular member.

3. A hypodermic injection device according to Claim 2, in which the said bushing is carried by and movable with the tubular member.

4. A hypodermic injection device according to any one of the preceding claims, in which the said stem is provided or formed with a passage through which access can be had to the space defined by the bore of the tubular member.

5. A hypodermic injection device according to Claim 4, in which a penetratable plug is disposed within the said passage.

6. A hypodermic injection device according to Claim 4 or Claim 5, in which a cap is carried by the body or casing in line with the passage in the stem.

7. A hypodermic injection device according to any one of the preceding claims, in which the movable retracting means comprises a pinion rotatably mounted on the body or casing and meshing with a rack carried by the tubular member whereby rotation of the pinion will cause retraction of the rack and the tubular member.

8. A hypodermic injection device according to any one of the preceding claims, in which releasable means are pro-

vided for retaining the tubular member in its retracted position.

9. A hypodermic injection device according to Claims 7 and 8, in which the said releasable means comprises a pawl which is resiliently urged into engagement with the pinion, means being provided for moving the pawl out of engagement with the pinion to free the rack and the tubular member for movement towards the projected position.

10. A hypodermic injection device according to Claim 1, having its parts constructed and arranged substantially as described with reference to Figures 1 to 3 or as modified with reference to Figure 5 of the accompanying drawings.

For the Applicants,
GILL, JENNINGS & EVERY,
Chartered Patent Agents,
51/52, Chancery Lane, London, W.C.2.

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1 SHEET

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